**CONNECTIVE TISSUE**

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H.I.R Chapter 5

All connective tissues have three components: cells, extracellular fibers and ground substance. It is the presence of these components in varying proportions which characterize each of the various types of connective tissue. The cellular elements may be fixed (as mesenchymal cells, fibroblasts, adipose, chondrocytes and osteocytes) or wandering (as macrophages, mast cells, white blood cells). The fixed cells produce and maintain the extracellular matrix, which is composed of the extracellular fibers and ground substance. There are 3 types of extracellular fibers: collagenous, reticular, and elastic. The ground substance is seemingly amorphous in nature and consists of glycosaminoglycans and proteoglycans, as well as the interstitial tissue fluid. It is the student's task to observe, compare, and be able to identify the various types of connective tissue and their components.

**LOOSE CONNECTIVE TISSUE**

[**[MCO 0006]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0006&type=ax&section=connectivetissue) Mesenchyme [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0006&type=jv&section=connectivetissue)

(Neural tubes) (Mesenchyme cells and extracellular matrix between cells)

\*\*\*Expect hylaronic acid to help promote migration during development

This is of an embryo which is folded so the body and the head are in the same plane of section. The neural tube is the dark stained, multilayered tube in the top and bottom part. The **mesenchyme** is outside these tubes as the lightest staining tissue. Mesenchyme is an embryonic connective tissue which is characterized by numerous stellate cells (mesenchymal cells). Only the nuclei of these cells are visible. The extracellular matrix is light staining and appears devoid of extracellular fibers.

[**[SL 024]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf4_SL024&type=ax&section=connectivetissue) Umbilical cord [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf4_SL024&type=jv&section=connectivetissue) HIR-*frames 51, 284-286*

 (Mucoid connective tissue = fibroblasts and ECM)

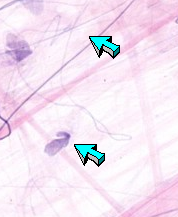
\*\*\*more material in extracellular space compared to mesenchyme (due to proteoglycans)

\*\*\*Three blood vessels tells you it is an umbilical cord

\*\*\*Contains proteoglycans 🡪 make turgid/rigid to prevent kinking (due to H2O uptake

There are three large dark staining bodies (blood vessels) present in this tissue at low power. The connective tissue that surrounds these bodies (and makes up the bulk of the organ) is called Wharton's jelly or **mucoid connective tissue**. This embryonic tissue is characterized by fibroblasts surrounded by many fine, blue staining fibrous elements in a mucoid ground substance. The mucoid tissue is very faintly stained blue. The fine fibers that you see are really large amounts of condensed glycosaminoglycans clumping on fine, sparsely scattered, collagen fibers. Be sure to be able to differentiate between mesenchyme and mucoid connective tissue.

[**[LH 0012]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf1_LH0012&type=ax&section=connectivetissue)Areolar tissue spread [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf1_LH0012&type=jv&section=connectivetissue) HIR-*frame 236-238, 240*

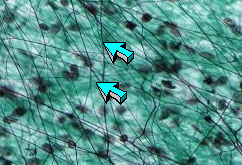
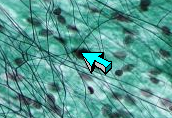
 

(Fibrocytes and elastic fibers) (Elastic Fibers and Collegen Fiber bundles [Type 1]) \*\*\*\*Irregular Areolar Connective Tissue (Areolar is always irregular)

\*\*\*Reticular Fibers are present too but they are not stained

\*\*\*Squiggly elastic fibers are cut fibers where tension has been released

[**[MCW 004]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf3_MCW004&type=ax&section=connectivetissue) Mesenteric spread, Verhoeff [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf3_MCW004&type=jv&section=connectivetissue)

(Elastic fibers = thin and black (Fibrocyte = darker nuclei)

Collagen fibers = Greyish-blue bundles)

In slide **LH 0012** the fibroblasts of the **areolar connective tissue** are difficult to visualize because of their transparent cytoplasm. Their ovale or elongate nuclei are dark staining. Macrophages or mast cells are difficult to identify and cannot be positively identified without special stains. Elastic fibers are dark staining and form a branching network of very fine fibers. The collagenous fibers are in bundles of broad light pink bands running in all directions. Remember that this slide is specially stained for elastic fibers and that areolar tissue does not appear like this with H & E stain. Areolar connective tissue can be found surrounding the small blood vessels and surrounding and between the secretory portions of the sweat glands in the next slide. The second slide, **MCW 004**, is stained for fine elastic fibers that appear black and branch with �Y�-shaped junction points. Broader, straight, gray-stained fibers are bundles of collagen fibers that are orientated in various directions. The smaller, darker-stained nuclei are probably fibroblast nuclei of the areolar connective tissue. The larger, lighter-stained nuclei are in the mesothelial cells covering the mesentery.

**[[MCO 0060]](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0060&type=ax" \t "_blank)** Trachea & Esophagus **[Java](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0060&type=jv" \t "_blank)**

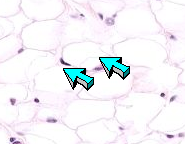
Look for plasma cells in the areolar connective tissue immediately subjacent to the pseudostratiefied columnar epithelium lining the lumen of the round trachea. There are numerous wandering cells in this layer. The **plasma cells** are characterized by eccentrically located nuclei and �cartwheel� chromatin pattern.



(Plasma cells in Areolar connective tissue = nucleus off to one side)

\*\*\*hard to see fibers and ground substance

**[[MCO 0652]](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0652&type=ax&section=epithelium" \t "_blank)** Axillary Skin, Human **[Java](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0652&type=jv&section=epithelium)** HIR- *frame 738*

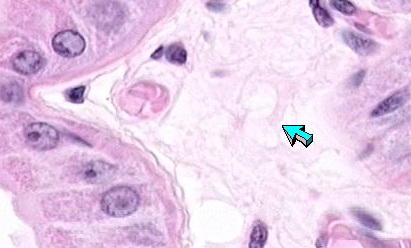
 

(Adipose connective tissue 🡪 (Dense Irregular connective tissue)

nuclei near plasma membrane) 🡪 Irregular = fibers in all directions

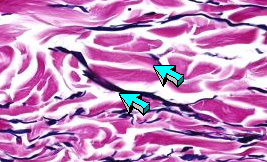
\*\*\*adipose = lacey white appearance \*\*\*Can see nuclei of fibrocytes

\*\*\*Fat cells will be scattered in Areolar



(Areolar Connective Tissue 🡪 No stain for fibers)

**[[UW 021]](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf7_UW120&type=ax" \t "_blank)** Skin (Elastic Stain) **[Java](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf7_UW120&type=jv" \t "_blank)**



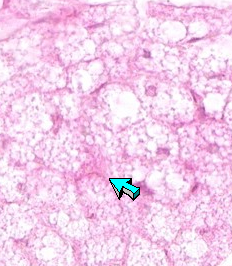
(Elastic Fibers = Black and Collagen type I fibers = pinkish)

\*\*\* Can tell difference in dense and areolar connective tissue by noticing that areolar tissue does not have as many and as thick of fiber

**[[LH 0060]](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf1_LH0060&type=ax" \t "_blank)** Nerve **[Java](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf1_LH0060&type=jv" \t "_blank) 🡪 Just will notice white adipocytes**

SEE DEMONSTRATION FOR ORIENTATION OF THIS SLIDE. Grossly, this organ can be divided into three visible areas. The thin, dark blue staining layer on bottom surface is the epithelium. Immediately subjacent to this is a thick, pink staining layer of dense irregular connective tissue. Subjacent to this pink layer (on the side opposite the epithelial layer), there is a very light staining lacy or spongy layer about twice as thick as the pink layer. This is a layer of **white adipose cells**. The fixed adipocyte or fat cell is found either as individual cells in loose connective tissue or as large masses to form white adipose tissue. The fat or lipid (the major component of this cell) has been dissolved during tissue preparation techniques leaving a large open space. The cytoplasm forms a delicate, barely visible ring around the outside of the fat droplet. The small dark staining nucleus is compressed against one side by the large lipid droplet. This gives the cell its "signet ring" description. Extracellular fibers are minimal. This is *white fat* with *unilocular* cells.

[**[MCO 0054]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0054&type=ax&section=connectivetissue) Entire heart LS [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0054&type=jv&section=connectivetissue) HIR-*frames 274-277 278-280*

** (Brown adipocytes🡪 Multilocular and aorta association)

 (Aorta with area with brown fat regions)

[**[MCO 0754]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0754&type=ax&section=connectivetissue)Entire Heart LS[**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0754&type=jv&section=connectivetissue)

SEE DEMONSTRATION FOR ORIENTATION OF THIS SLIDE. Look for a small mass of brown fat tissue around the aorta or pulmonary trunk of the heart. Brown fat is usually located adjacent to the great vessels in small rodents and human newborns.

**Brown fat** is a light pink staining, foamy-appearing mass along side of the aorta. The individual cells appear foamy due to extraction of the numerous lipid vacuoles within the cytoplasm. The nuclei of these *multilocular* cells are round and not flattened against the cell membranes as those of the unilocular fat cells. Both white and brown fat cells can be observed in this region.

**DENSE CONNECTIVE TISSUE**

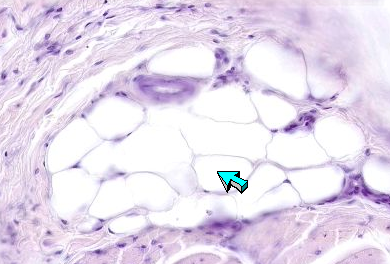
[**[MCO 0052]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0052&type=ax&section=epithelium) Axillary Skin, Human [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0052&type=jv&section=epithelium) HIR- *frame 719, 738*

[**[MCO 0652]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0652&type=ax&section=epithelium) Axillary Skin, Human [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0652&type=jv&section=epithelium)

[**[UW 021]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf7_UW120&type=ax) Skin (Elastic Stain) [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf7_UW120&type=jv)

The pink staining layer between the adipose tissue and the dark staining epithelium consists of **dense irregular connective tissue**. It is characterized by scattered fibroblasts (dark staining nuclei) and large pink staining bundles of collagenous fibers. The bundles are interwoven and run in all directions. The interwoven collagenous bundles help the skin resist stress and strain from all directions. Contrast this connective tissue with the lighter staining areolar connective tissue that immediately surrounds and is located between the glandular elements at the junction of the dense irregular connective tissue layer and the fat layer. Slide UW 021 is specifically stained for elastic fibers. Look in the dense irregular connective tissue layer of the dermis for the black branching fibers or dots (in cross section) scattered between the bundles of pink-staining collagen fibers.

[**[MCO 0009**]](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0009&type=ax&section=connectivetissue) Tendon [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0009&type=jv&section=connectivetissue) HIR-*frames 266, 267*

(White Adipocytes) (Dense regular connective tissue

Fibrocyte Nuclus)

\*\*\*Collagen Fibers create Striations



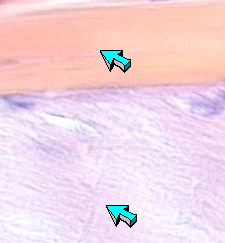
(Areolar Connective Tissue and Fibrocyte Nuclei from dense regular connective tissue)

\*\*\*Tell difference between dense regular connective tissue by nuclei location 🡪

In muscle nuclei on the periphery and in dense Regular connective tissue nuclei are scattered

\*\*\*Developmental origin of all connective tissue is mesenchyme

[**[SL 077]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf4_SL077&type=ax&section=connectivetissue)Tendon [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf4_SL077&type=jv&section=connectivetissue)

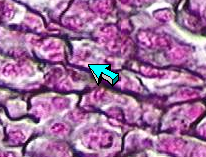
** (Dense regular connective tissue and muscle cells)**

**\*\*\*Muscle cells have striations**

**Dense regular connective tissue** has numerous collagenous fiber bundles aligned parallel to each other in one direction. This is usually along the main axis of stress. This gives the tendon flexibility, but it is also very tough and strong. In **MCO 0009**, the dark staining fibroblast nuclei are sandwiched between the wavy, pink staining bundles of collagenous fibers. A small amount of areolar connective tissue separates the secondary bundles and carries the small blood vessels. Note the bundle arrangement in cross section. The fibroblast *nuclei* embedded within the bundles appearalmost stellate in cross-section. This tissue is very similar in appearance to skeletal muscle i.e., they are "histological look-alikes�. This is also a histological look-alike with longitudinally-sectioned smooth muscle tissue. You will learn how to differentiate these tissues when you cover the muscle tissue in greater detail. The red staining tissue in **SL 077** is the dense regular connective tissue of the tendon that is surrounded by pink-staining, striated, skeletal muscle cells.

**EXTRACELLULAR FIBERS**

[**[MCO 0011]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0011&type=ax&section=connectivetissue)Reticular tissue [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0011&type=jv&section=connectivetissue) HIR-*frames 281-283*

 (Reticular Fibers because of special staining)

\*\*\*Reticular Cells secrete these fibers and are distinguished from elastic fibers because these are more squiggly and join at right angles

**Reticular fibers** are usually found in lymph nodes where they form a delicate internal framework surrounded by wandering cells (lymphocytes), as seen on this slide. The fine reticular fibers are black staining because of their affinity for silver. These fibers are composed of collagen type III with a sugar (glycoprotein) coating which has the affinity for silver. The branching network of reticular fibers appears as dots (cross section) and long fibers in this **reticular tissue**. These fibers branch more at right angles than elastic fibers which appear as "Y" branches. In addition, the elastic fibers are long and unbroken between branch points while the reticular fibers have a crooked appearance to the fibers. Be able to identify these fibers at both the LM an EM level.

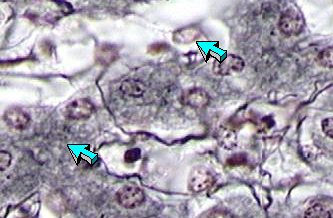
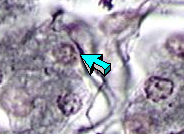
[**[MCW 051**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf3_MCW051&type=ax&section=connectivetissue)**]** Lymph Node w/Carbon Reticulum [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf3_MCW051&type=jv&section=connectivetissue)



(Reticular fibes 🡪 black squiggles and Macrophages 🡪 large dark staining cells)

The black-stained reticular fibers and their characteristic branching can readily be seen in both the cortex (periphery) and the darker staining medulla (central region) of this reticular tissue in a lymph node. The round, dark-stained nuclei of wandering lymphocytes are located within the spaces of the reticular fiber framework. The large dark staining cells in the medullary region are the carbon-filled macrophages.

[**[MCW 086]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf3_MCW086&type=ax&section=connectivetissue) Liver Reticulum [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf3_MCW086&type=jv&section=connectivetissue)

(Endothelial cells and hepatocytes) (Reticular Fibers)

This slide demonstrates that reticular fibers are present in numerous organs to add delicate support to the tissues. The branching framework of black-stained, crooked fibers support the hepatocytes as well as the endothelial cells of the sinusoids.

[**[MCO 0010]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0010&type=ax&section=connectivetissue) Ligamentum Nuchae [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0010&type=jv&section=connectivetissue) *[See demonstration]*



(Coss-section elastic fibers and Fibrocyte Nucleus)



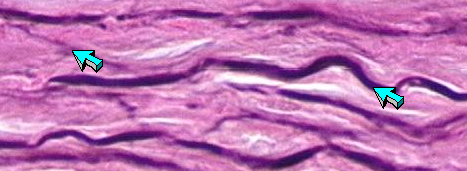
(Dense Regular Connective Tissue and Y-splitting Elastic Fibers)

\*\*\*darker Pink Staining Substance is the ground substance

The morphology of this **elastic tissue** can be clearly seen. The elastic fibers are stained light yellow. The ground substance is stained red and the fibroblast nuclei are small, dark, angular masses squeezed between the fibers in cross section.

In longitudinal section, the large elastic fibers in this elastic ligament are longitudinally-oriented and are �Y� branched. The pink staining material between the elastic fibers is ground substance with a small amount of collagenous fibers. Some of the elastic fibers appear wavy due to the release of tension during cutting the tissue.

[**[MCO 0056]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0056&type=ax&section=connectivetissue) Aorta, Human, Elastic Tissue [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0056&type=jv&section=connectivetissue) HIR-*frames 262 582-588*



(Lamellae = darker and elastic fibers = run between adjacent lamellae)

[**[SL 047]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf4_SL047&type=ax&section=connectivetissue) Aorta [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf4_SL047&type=jv&section=connectivetissue)

The sheets or lamellae (lamina) of elastic consist of the dark staining wavy lines in the wall of the aorta. They are roughly parallel to the luminal surface of the vessel. Finer elastic fibers interconnect the thicker elastic sheets. Aside from orientation and thickness, the sheets of elastic lamina and the elastic fibers appear the same because of the plane of section artifact. A longitudinal section of an elastic sheet would appear as a line in a 2-dimensional image, just as a complete elastic fiber would appear. The cellular elements are not clearly visible between the dark staining lamellae.